CLAIMS

1. Process for preparing a three-dimensional digital image for realising a biomorphic multicompartmental phantom, representing at least one organ and/or at least one system belonging to a living being, comprising a first phase A.1 of acquisition of images or "sequences" of the organ or of the system belonging to the living being, according to predefined acquisition parameters, forming a volumetric image defined by voxels, further comprising a phase A.2 of identification of tissues and/or tissue liquids and a phase B of selection of at least three of said tissues and/or tissue liquids, the process being characterised in that it comprises the following phases:

C.1 verifying the adjacency of the voxels, so that each tissue or tissue liquid defines a connected volume representing the tissue or tissue liquid itself;

C.3 preparing an image presenting the surfaces of the volumes defined in phase C.1 according to the following sub-phases:

C.3.2 determining a number of surfaces equal to the number of tissues, such that they result internal to one another, even if partially tangent, said surfaces being the convolution of the surfaces of one or more volumes defined in phase C.1, said surfaces giving, by addition or subtraction, all the surfaces corresponding to the tissues or tissue liquids selected in phase B;

C.3.3 assigning a thickness to said surfaces, so that in the portions wherein two or more surfaces are tangent to one another the thickness is assigned to only one surface, the set of said thicknesses forming a connected volume.

2. Process according to claim 1, characterised in that phase C.1 comprises the following sub-phases:

C.1.1 selecting a voxel from the set of voxels forming the whole acquired volume;

C.1.2 comparing the selected voxel with a neighbourhood of six voxels which are connected to it through one face;

C.1.3 if another voxel of the same type (belonging to the same tissue or tissue liquid) does exist in said neighbourhood, examining the neighbourhood of this one, and so on recursively;

C.1.4 if during phase C.1.3 an island of one or more connected voxels of the type selected in phase C.1.1 is identified, which is

surrounded by one or more volumes of voxels of other types, carrying out the following sub-phase:

C.1.4.1 if said island has size smaller than a predetermined threshold, assigning the voxels of said island to the tissue which is most represented in a region including the island.

3. Process according to claim 1 or 2, characterised in that it further comprises, after phase C.1.4.1, a phase C.1.4.2 wherein, according to the method of the previous phases, the existence of islands having size larger than said threshold is verified and, in the positive, one of the following sub-phases is alternatively carried out:

- reassign the island to one of said tissues or tissue liquids;
- connecting the island, through a channel, to one of said tissues or tissue liquids.

4. Process according to any one of the claims 1 to 3, characterised in that it further comprises a phase C.2 of smoothing the images in the three dimensions.

5. Process according to any one of the claims 1 to 4, characterised in that phase B further comprises the following phases:

B.1 eliminating all the tissues except a predetermined set of tissues;

B.2 filling the holes by assigning the corresponding voxels to at least one tissue of the predetermined set.

6. Process according to any one of the claims 1 to 5, characterised in that it carries out, before phase C.3.2, the following phase:

C.3.1 transforming the vector representation of the voxels into the vector representation of the surfaces separating the several tissues.

7. Process according to any one of the claims 1 to 6, characterised in that the organ of the living being, the images of which are acquired in phase A.1, is the brain of a superior primate.

8. Process according to claim 7, characterised in that the organ of the living being, the images of which are acquired in phase A.1, is the brain of a human being.

9. Process according to claim 7 or 8, characterised in that during phase A.1 it is acquired a number of axial images ranging from 60 to 300, with layers having thickness ranging from 1 to 4 mm and with

spacing from a centre to another one ranging from 0,5 to 2 mm, said images representing axial sections of the brain.

10. Process according to claim 9, characterised in that said images which are acquired are MRI images.

11. Process according to claim 9 or 10, characterised in that the T1-w and PD-T2-w sequences are acquired for each localization of layer.

12. Process according to any one of the claims 7 to 11, characterised in that said at least three tissues or tissue liquids selected in phase B are the grey matter, the white matter and the encephalorachidian liquid.

13. Process according to any one of the claims 7 to 12, characterised in that during phase C.3.2 a first surface containing the white matter plus the grey matter, a second surface containing only the grey matter, and a third surface representing the cranium surface are selected, the volume containing the encephalorachidian liquid and the volume containing only the white matter being obtained by subtraction between said surfaces.

14. Process according to any one of the claims 7 to 13, characterised in that phase B has a phase B.3 in which the definition of the tissues in the images under processing is corrected.

15. Process according to claim 14, characterised in that in phase B.3 the definition and the form of the basal ganglia of the brain are improved.

16. Process according to any one of the previous claims, characterised in that the image obtained from phase C.3.3 is modified so as to create channels entering the compartments/chambers corresponding to the selected tissues or tissue liquids, said channels being used for filling and emptying the phantom.

17. Apparatus for processing images starting from images of an organ of a living being, characterised in that it automatically carries out in a configurable mode phases A.1 and A.2 according to claim 1, and also phases B and C according to any one of the claims 1 to 16.

18. Computer program characterised in that it comprises code means adapted to execute, when running on a computer, the process according to any one of the claims 1 to 16.

19. Memory medium readable by a computer, storing a program, characterised in that the program is the computer program according to claim 18.

20. Biomorphic multicompartmental phantom, suitable for multianalytical examinations, characterised in that it is produced through a rapid prototyping device using the images processed according to the process according to any one of the claims 1 to 16, the surfaces having thickness being made of solid synthetic matter and the volumes representing the various tissues and/or tissue liquids being left empty and so forming several fillable compartments.

21. Phantom according to claim 20, characterised in that the rapid prototyping device is a stereolithographer.

22. Phantom according to claim 20 or 21, characterised in that said compartments are filled with water or solutions containing radioisotopes, for its use in Nuclear Medicine.

23. Phantom according to claim 20 or 21, characterised in that said compartments are filled with solutions of contrast media or paramagnetic ions, for use in Computerised Axial Tomography and Magnetic Resonance.

24. Phantom according to claim 20 or 21, characterised in that said compartments are filled with aqueous solutions of nickel and/or manganese and/or gadolinium.